Data Description

1. PROJECT

Title: Impact of sea ice floe size distribution on seasonal fragmentation and melt of Arctic sea ice.
Funding organisation: NERC industrial CASE studentship with the UK Met Office, reference NE/M009637/1.

2. DATASET

Title: Simulations with the sea ice model CICE investigating the impact of sea ice floe size distribution on seasonal Arctic sea ice retreat.

To produce this dataset a CPOM (Centre for Polar Observation and Modelling) version of the Los Alamos Sea Ice model v 5.1.2, hereafter referred to as CICE, is used (Hunke et al., 2015). This local version also includes the prognostic mixed layer model of Petty et al. (2014) and additional state-of-the-art parameterisations not included in the general CICE distribution based on recent work by Schröder et al. (2019). Further details on the CICE model used here are given within Bateson et al. (2019), section 2.1.

This dataset has been generated by implementing a power law derived sea ice floe size distribution model, hereafter referred to as the WIPoFSD model (Waves-in-Ice module and Power law Floe Size Distribution model), within CICE. The WIPoFSD model is adapted from an implementation developed at the National Oceanography Centre of the UK within a coupled sea ice-ocean framework, called the NEMO-CICE-Waves-in-Ice (WIM) model (Hosekova et al., 2015; NERSC, 2016). Both models include a wave attenuation and floe break-up model based on the Waves-in-Ice Model from the Nansen Environmental and Remote Sensing Center (NERSC) Norway (Williams et al., 2013a, 2013b).

We use this dataset within the associated paper (Bateson et al., 2019) to investigate the impact of floe size on the seasonal fragmentation and melt of Arctic sea ice. We document several findings including that the WIPoFSD model has a spatially and temporally dependent impact on the sea ice cover, in particular enhancing the role of the marginal ice zone in sea ice loss. We also show a strong model sensitivity to floe size distribution parameters within limits constrained by observations. We furthermore find that the impact of waves on floe size and the sea ice cover is strongly moderated by the wave attenuation rate.

A full description of data processing and associated uncertainties can be found within Bateson et al. (2019). A full description of all the simulations included in this dataset is also given.

Publication Year: 2019
Creator: Adam Bateson
Organisation: University of Reading

3. TERMS OF USE
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4. CONTENTS

File names are constructed using the following format:

cice_cpom_wipofsd_X, where X corresponds to the letter assigned to each simulation in table 2.
cice_cpom_wipofsd_dmax-dmin-α, for the simulations described in section 4.2 where dmax, dmin and α are as defined in table 1.
cice_cpom_wipofsd_X_dmax-dmin-α, for simulations used within section 4.2 and listed in table 2.

All data is stored in netCDF format within: wipofsd_simulations.tar.gz.

There are three types of datasets:

A. Monthly means on our 1deg tripolar grid are provided between 2005 - 2016.

data variables:

-1	hi_m	grid cell mean ice thickness [m]
-2	aice_m	ice area (aggregate) [1]
-3	meltt_m	top ice melt [cm/day]
-4	meltb_m	basal ice melt [cm/day]
-5	meltl_m	lateral ice melt [cm/day]
-6	l_mean_m	mean floe size [m]
-7	l_eff_m	effective floe size [m]
-8	maxfloe_m	maximum floe size [m]
-9	pfloe_m	floe perimeter [m]
-10	Hs_wave_m	reconstructed significant wave height [m]

cice_cpom_wipofsd_ref.nc
cice_cpom_wipofsd_10000-10-2.5.nc
cice_cpom_wipofsd_1000-10-2.5.nc
cice_cpom_wipofsd_30000-10-2.nc
cice_cpom_wipofsd_A_30000-10-3.5.nc
cice_cpom_wipofsd_30000-10-3.nc
cice_cpom_wipofsd_30000-1-2.5.nc
cice_cpom_wipofsd_30000-1-2.nc
cice_cpom_wipofsd_B_30000-1-3.5.nc
cice_cpom_wipofsd_30000-1-3.nc
cice_cpom_wipofsd_30000-20-2.5.nc
cice_cpom_wipofsd_30000-20-3.5.nc
cice_cpom_wipofsd_30000-20-3.nc
cice_cpom_wipofsd_30000-50-2.5.nc
cice_cpom_wipofsd_C_30000-50-2.nc
cice_cpom_wipofsd_30000-50-3.5.nc
cice_cpom_wipofsd_30000-50-3.nc
cice_cpom_wipofsd_50000-10-2.5.nc
cice_cpom_wipofsd_F.nc
cice_cpom_wipofsd_G.nc
cice_cpom_wipofsd_H.nc
cice_cpom_wipofsd_I.nc
cice_cpom_wipofsd_J.nc
cice_cpom_wipofsd_K.nc
cice_cpom_wipofsd_L.nc
cice_cpom_wipofsd_M.nc
cice_cpom_wipofsd_N.nc
cice_cpom_wipofsd_O.nc
cice_cpom_wipofsd_P.nc
cice_cpom_wipofsd_Q.nc

cice_cpom_wipofsd_stan-fsd_30000-10-2.5.nc

B. Monthly means on our 1deg tripolar grid are provided between 2005 - 2016.

-1	hi_m	grid cell mean ice thickness [m]
-2	aice_m	ice area (aggregate) [1]
-3	meltt_m	top ice melt [cm/day]
-4	meltb_m	basal ice melt [cm/day]
-5	meltl_m	lateral ice melt [cm/day]
-6	l_mean_m	mean floe size [m]
-7	l_eff_m	effective floe size [m]
-8	l_exp_m	power law exponent
-9	maxfloe_m	maximum floe size [m]
-10	pfloe_m	floe perimeter [m]
-11	Hs_wave_m	reconstructed significant wave height [m]

cice_cpom_wipofsd_D.nc
cice_cpom_wipofsd_E.nc

C. Daily means on our 1deg tripolar grid are provided between 2005 - 2016.

-1	hi_d	grid cell mean ice thickness [m]
-2	aice_d	ice area (aggregate) [1]
-3	meltt_d	top ice melt [cm/day]
-4	meltb_d	basal ice melt [cm/day]
-5	meltl_d	lateral ice melt [cm/day]
-6	l_mean_d	mean floe size [m]
-7	l_eff_d	effective floe size [m]
-8	maxfloe_d	maximum floe size [m]
-9	pfloe_d	floe perimeter [m]
-10	Hs_wave_d	reconstructed significant wave height [m]

cice_cpom_wipofsd_ref_daily.nc
cice_cpom_wipofsd_stan-fsd_30000-10-2.5_daily.nc
cice_cpom_wipofsd_F_daily.nc
cice_cpom_wipofsd_K_daily.nc

The following files are also included:

cice_cpom_init_1stJul05.nc

This file is the output of the spin-up between 1990 – 2004 using the reference setup and used to initiate all simulations.

grid_info.nc

grid variables:

-1 TLAT, geographical latitude of grid cells
-2 TLON, geographical longitude of grid cells
-3 tarea, area of grid cells [m^2]

5. REFERENCES

Bateson, A. W., Feltham, D. L., Schröder, D., Hosekova, L., Ridley, J. K. and Aksenov, Y.: Impact of floe size distribution on seasonal fragmentation and melt of Arctic sea ice, Cryosph. Discuss., doi:10.5194/tc-2019-44, 2019.

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Hunke, E. C., Lipscomb, W. H., Turner, A. K., Jeffery, N. and Elliott, S.: CICE : the Los Alamos Sea Ice Model Documentation and Software User ' s Manual LA-CC-06-012, , 115, 2015.
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Schröder, D., Feltham, D. L., Tsamados, M., Ridout, A. and Tilling, R.: New insight from CryoSat-2 sea ice thickness for sea ice modelling, Cryosph. Discuss., 1–25, doi:10.5194/tc-2018-159, 2019.
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Williams, T. D., Bennetts, L. G., Squire, V. A., Dumont, D. and Bertino, L.: Wave-ice interactions in the marginal ice zone. Part 2: Numerical implementation and sensitivity studies along 1D transects of the ocean surface, Ocean Model., 71, 92–101, doi:10.1016/j.ocemod.2013.05.011, 2013b.